Iowa Science Teachers Journal

Volume 23 | Number 2 Article 3

1986

Survey Shows Chemistry Textbooks and Teaching Practices in Iowa to Be Conventional

Robert W. Hanson
University of Northern Iowa

SURVEY SHOWS CHEMISTRY TEXTBOOKS AND TEACHING PRACTICES IN IOWA TO BE CONVENTIONAL

Robert W. Hanson
Late professor of Chemistry and Science Education
University of Northern Iowa
Cedar Falls, Iowa 50614

Part of a survey of the 485 high school chemistry teachers in Iowa in the spring of 1984 dealt with the textbooks used in chemistry courses offered in their schools and with changes in emphasis in teaching chemistry during the past three years. The target group of teachers included 455 from public schools and 30 from parochial schools. Seventy-eight percent of the public school and fifty percent of the parochial school teachers responded. Schools and school districts of all sizes were represented among the respondents.

A similar survey (Hanson, 1979) taken in 1978-79 provided an almost complete list of the textbooks used in chemistry at that time. That earlier survey showed that one self-paced program (PACE) was used in 39 schools involving about 1,232 students. The current survey indicated that only 5 schools are using this or any other self-paced program. The PACE program is out of print; a new program called "Structured Pacing in Chemistry Education" (SPICE) is available. As its name implies it is not as "self-paced" as PACE was designed to be, but it has not been adopted to any great extent.

The most-used textbook in terms of both number of teachers, school districts and students continues to be *Modern Chemistry* published by Holt, Rhinehart and Winston. However, the second place in popularity has changed from the *CHEMS* revisions to Smoot, Price and Smith's *Chemistry: A Modern Course*, published by Merrill. The Holt and Merrill books are in use by an estimated 64 percent of the students taking the basic chemistry course, with a 4 percent edge for *Modern Chemistry*. A relative newcomer, *Chemistry* written by Masterton, Slowinski and Walford and published by Saunders is used by about 10 percent of the state's chemistry students, but adoption in a couple of large districts accounts for most of this number. The remaining 22 percent of chemistry students are in 83 districts and use a variety of different textbooks, none of which is used by more than 4 percent of the students in basic chemistry. Table 1 lists most of the textbooks in use in Iowa. The estimates of student numbers are based on district enrollment in grades 10-12 and the assumption that half of the grade 10 students take chemistry. These are not exact enrollment figures and should be interpreted accordingly.

The most widely-used textbooks share the same characteristics and are conventional in most respects. They continue to stress the more esoteric aspects of chemistry with only token consideration of descriptive chemistry, consumer concerns or societal issues. They do not represent truly new approaches to organizing subject matter, and their popularity implies that high school chemistry in Iowa is conventional. Even so, teacher attitudes and expectations cover a wide latitude, as shown by the current survey.

The survey also dealt with changes that teachers had made in their teaching

Table 1
TEXTBOOKS USED IN HIGH SCHOOL CHEMISTRY IN IOWA

Publisher	Title (Author)	Public School Districts	Estimated Students*(%)
Holt	Modern Chemistry (Dull, *et al*)	132	34.0
Merrill	Chemistry: A Modern Course (Smoot, *et al*)	74	29.7
Saunders	Chemistry (Masterton, *et al*)	23	9.6
Silver Burdett	Chemistry (Choppin, *et al*)	20	4.1
Prentice-Hall	Chemistry: Experimental Foundations (Parry, *et al*)	14	4.4
Houston Mifflin	Chemistry: An Investigative Approach (Cotton, *et al*)	8	3.2
Harper and Row	Interdisciplinary Approaches to Chemistry (Atkinson, *et al*)	4	2.6
Cebco	Chemistry, the Study of Matter	5	2.1
Heath	Chemistry: Experiments and Principles (O'Connor, *et al*)	10	1.4
Holt	Foundations of Chemistry (Toon and Ellis)	2	0.6
Harcourt	Concepts in Chemistry (Harrison and Greenstone)	4	0.2
Holt	Action Chemistry (Bolton, *et al*)	1	0.4
(Out of print)	PACE: Personalized Adventures in Chemical Education	2	0.8
Price Lab. School	SPICE: Structured Pacing in Chemistry Education (Kelly, *et al*)	3	1.2
None	"Self-written" (no text)	2	0.8
	Other textbooks (one teacher each)	8	3.3

*Estimated from district enrollment; public schools only.

during the past three years (Table 2). Among the changes that showed decreased emphasis were self-pacing and individual projects. Some increased emphasis was indicated in the level of abstract concepts. Greater use of mathematics was indicated by many respondents. Increased use of computers was reported more than any other change. These and some other changes are listed below with the number of teachers who indicated increased or decreased emphasis or no change.

If one assumes that the status quo was favored by teachers who made no changes in emphasis, the past three years have not brought sweeping changes in the way chemistry is taught. This period of time corresponds roughly to the widespread publicity claiming that America's science education effort is seriously ineffective.

One question included in the current survey asked, "Have you noticed any changes in student attitudes toward their chemistry studies during the recent emphasis about inadequate science achievement by U.S. students?" There were 326 responses to this query. Some of the responses mentioned the positive effect of financial incentives offered by the state to students taking more science

Table 2
CHANGES MADE BY TEACHERS

	Responders by percent		
	More	Less	No Change
Theoretical/abstract concept emphasis	25.6%	10.2%	64.2%
Descriptive chemistry	30.1%	5.1%	64.9%
Consumer-oriented content	30.1%	5.1%	64.9%
Mathematics usage	43.1%	7.9%	49.0%
Laboratory emphasis	32.6%	7.3%	53.0%
Use of individual projects	10.1%	20.5%	69.4%
Self-pacing	6.2%	20.8%	73.0%
Homework	38.2%	3.9%	57.0%
Use of computers	47.0%	0.0%	53.0%

and mathematics courses and more recognition that chemistry is important for success in college. Nevertheless 179 teachers said they observed no change in student attitudes, and that the reputation of chemistry persisted as a course that lowers grade-point averages.

Another question dealt with ways of "improving student performance" and "increasing enrollment." One-fifth of the respondents made no comment on this question. Some who responded tended to look upon these as two opposing objectives, noting that increasing enrollment would encourage less qualified students to take chemistry, thus reducing the average level of performance.

Responses that focused on the student emphasized the need for better mathematics background (42), better junior high preparation (8) and better attitudes of students and parents (24).

Improving the quality of instruction by making the course more relevant to student interest and experience was mentioned by 36 teachers. A similar number mentioned the need for better laboratory experiments and more emphasis on laboratory work. A variety of other suggestions dealt with such things as better teacher preparation (18), better guidance counseling (18), more preparation time (16), more money for equipment (15) and greater emphasis on logical thinking (10).

A consensus is not apparent from these and other responses. However, the need for course content that is more relevant to student needs and interests, and for more and better laboratory work was perceived by an appreciable number of teachers, in keeping with the recommendations of professional groups, including the American Chemical Society and the National Science Teachers Association.

In 1980 the National Science Foundation funded a project called "Project Synthesis." The report of that project was published by the Foundation in 1982, titled *The Status and Needs of PreCollege Science Education.* Later a committee chaired by J.D. Herron undertook to determine the "desired state" of chemistry teaching in secondary schools, modeling their study after Project Synthesis. The final report of Herron's committee (Herron, unpub.) described the current state of chemistry teaching as well as the desired state. The results of the recent Iowa survey are not inconsistent with the statements of Herron's committee, particu-

larly the observation that chemistry teaching in secondary schools today emphasizes the goal of academic achievement almost to the exclusion of other desirable goals, (personal needs, societal issues and career education), and that, in many schools, the chemistry offered is attractive only to students who are highly motivated, academically able, and interested in science.

The desired state of chemistry teaching in the secondary school has been the same for several decades, according to Herron's committee. They claim that all secondary school students should study chemistry, but that such study need not be in a course called "chemistry." Such study, whether in a course called "chemistry" or not, should relate to societal issues of personal interest to the student. Intellectual skills needed for rational thought should be emphasized to enable students to learn on their own. Career information should be included to aid students in making decisions about their futures, and the chemistry taught should provide adequate background for post-secondary education without requiring the learning of technical skills that have little value to them.

Some arrangements are likely to be more effective than others in achieving these goals. The wide range of expectations apparent among chemistry teachers will probably continue, and innovative approaches will probably be the exception. Chemistry courses will most likely continue to be textbook-oriented, and available textbooks will continue to be influenced more by market research than by pedagogical research. Providing alternative courses such as "consumer chemistry" or "advanced chemistry" is one option for meeting student needs, but district enrollment has much to do with the availability of such courses. Iowa's school districts range in size from about 100 to over 30,000. Half of Iowa's students are in districts with enrollments under 700. Iowa schools that offer anything other than "Chemistry I" are few, and an "advanced" course is more likely to be offered than a general education alternative, according to this survey and information from the Department of Public Instruction.

Some imaginative changes are needed in the typical high school chemistry course if more students are to be exposed to this important area of science. The challenge of making the course more appropriate for more students while at the same time not neglecting important concepts is demanding. The need for change has been recognized by the Education Committee of the American Chemical Society, and toward that end a new interdisciplinary high school course is being developed that should be ready for use in 1986, according to a report in *Chemunity '84*. The course, called "Chemistry in the Community," is written for a wider student audience than most popular textbooks. The course will consist of eight modules titled:

I. Examining the Quality of Our Water
II. Conserving Chemical Resources
III. Petroleum: To Build and to Burn
IV. Feeding the World
V. Nuclear Chemistry in Our World
VI. Chemicals, Air and Climate
VII. Chemistry and Health
VIII. The Chemical Industry

The year-long course (abbreviated "ChemCom") is currently being pilot-

tested. Reactions so far have been positive and the change from more traditional approaches has not entailed a loss of any of the basic concepts vital to an introductory course. (The *Chemunity* report lists the chemical concepts utilized in the ChemCom modules.)

This effort by the American Chemical Society is in keeping with the "desired state" of chemistry teaching envisioned by Herron's committee. It shows that imagination and effort combined with an understanding of student needs can bring chemistry to more students. Whether this or any other innovative approach will be adopted by Iowa's chemistry teachers remains to be seen. To reach the "desired state" of chemistry teaching will require an effort on the part of the colleges and universities that offer pre-service and in-service programs for chemistry teachers as well as motivation from high school teachers and administrators.

References

ChemCom Project Enters Phase II. 1984. *Chemunity '84.* 5(4):8.

Hanson, R.W. 1979. Preferences and Practices in High School Chemistry in Iowa, *Proc. Iowa Acad. Sci.* 86, 76.

Herron, J.D., *et al. FINAL REPORT: The Desired State of Chemistry Teaching in Secondary Schools,* unpublished.